TABLE V.—*Agglutination tests to determine whether control serums 10, 13, and 18, found positive by the complement fixation test (see Table IV), would be negative by agglutination. Antigen used G 32. Test made June 16, 1921.*

Serum.	Serum dilutions.						Results.
	1:10	1:20	1:40	1:100	1:200	1:400	
Laboratory cases:							
Case 1	4+	4+	3+	+	−	−	Positive.
Case 2	4+	4+	3+	2+	−	−	Do.
Case 3	+	2+	4+	4+	2+	−	Do.
Case 4	4+	4+	4+	4+	3+	−	Do.
Case 5	+	3+	4+	3+	2+	−	Do.
Control serums:							
A	−	−	−	−	−	−	Negative.
No. 1	−	−	+	2+	−	−	Slightly positive (?).
No. 2	−	−	−	−	−	−	Negative.
No. 3	−	−	−	−	−	−	Do.
No. 4	−	−	−	−	−	−	Do.
No. 5	−	−	−	−	−	−	Do.
No. 10	−	−	−	−	−	−	Do.
No. 13	−	−	−	−	−	−	Do.
No. 18	−	−	−	−	−	−	Do.

TABLE VI.—*Agglutination test made Aug. 5, 1921, on serum of laboratory case 6 taken on the nineteenth day of his illness. This patient had furnished negative control serum A 51 and 87 days previously. (See Tables III, IV, and V.) All serums taken Aug. 5 and heated 30 minutes at 55° C. before using. Antigen used G 32.*

Serums.	Serum dilutions.							Results.
	No serum.	1:20	1:40	1:80	1:200	1:400	1:800	
Laboratory cases:								
Case 6	−	2+	3+	2+	2+	+	−	Positive.
Case 3	−	2+	2+	2+	+	−	−	Do.
Case 4	−	3+	3+	2+	+	−	−	Do.
Control serums:								
No. 1	−	−	−	−	−	−	−	Negative.
No. 2	−	−	−	−	−	−	−	Do.
No. 3	−	−	−	−	−	−	−	Do.
No. 4	−	−	−	−	−	−	−	Do.
No. 5	−	−	−	−	−	−	−	Do.
No. 6	−	−	−	−	−	−	−	Do.

RECORDS OF THE SMALL SICK-BENEFIT ASSOCIATION AS A SOURCE OF STATISTICS FOR THE FACTORY MEDICAL DEPARTMENT.[1]

By DEAN K. BRUNDAGE, United States Public Health Service.

The keeping of adequate sickness records for the employees of an industrial establishment is no easy proposition. As a general rule the industrial physician finds it exceedingly difficult to obtain the fundamental information required for efficient administration of the factory health department. How, for example, can the ailments causing disability be ascertained for employees absent from work on account of illness? How can trustworthy sickness *rates* be obtained when such rates require as the dividend in the expression, *all* cases

[1] From the Statistical Office, United States Public Health Service.

lasting longer than a certain minimum length of time as, for example, all cases lasting longer than one day, or longer than two days, etc., and require as divisor the number of persons in the group under consideration?

The first difficulty has doubtless retarded the development of industrial morbidity statistics as much, if not more, than any other single factor. It is not an insurmountable obstacle, however, and becomes less of a problem the longer an illness lasts. When disability is continuous for several days or a week, a fairly accurate diagnosis generally is obtainable.

Both difficulties are largely obviated when some form of sickness insurance is provided for the employees of a company, for then a record must be kept of all cases of sickness and nonindustrial accidents lasting longer than a certain specified number of days called the waiting period. Since cases must be reported before benefits may be paid, an economic incentive insures the inclusion of practically all cases coming under the provisions of the association.[2]

In the reporting of cases a physician's certificate naming the ailment causing absence from work is almost always called for, so that fairly accurate diagnosis of disease generally may be assumed. Not only are the case reports of value, but what is of almost equal importance from the statistical standpoint is the fact that information concerning age, sex, nationality, occupation, and the duration of membership usually is shown on the application blank or membership register. Personnel data of this sort are of fundamental importance in studying and comparing the morbidity experience of different population groups.

With a record of the composition of membership and of certain cases of disability occurring among members, disease incidence and severity rates can be computed for different age, sex, and nationality groups and for different occupations, and the important factors affecting the frequency and duration of disability can be analyzed and evaluated. The industrial physician in a plant having an organization for sickness insurance therefore need not even temporarily dispense with morbidity statistics. The material available in the office of the benefit association can be used to advantage until a more complete sickness record system is devised for the study of industrial hygiene in its broader aspects. Exception to this statement is to be taken in the case of the small association composed of only a fraction of the plant personnel; for if the records of the association are to serve as a reliable index of the health of the entire working force, the membership of associations of less than 1,000 persons must constitute a high percentage of the number employed.

[2] Not all illnesses, however, are included, since most associations do not pay benefits for the venereal diseases, the results of intoxication, and for certain other causes of disability.

Assuming, however, that an adequate proportion of the employees of an establishment belong to the factory sick-benefit association, what useful information is to be obtained by analyzing the association's records?

An attempt is made in the following pages to answer this question in a specific instead of a general way. An analysis is presented of the monthly reports of a small employee sick-benefit association cooperating with the Public Health Service in the study of industrial morbidity. The association has a waiting period of four calendar days, and benefits may be paid for a period not longer than 52 weeks. A small association was selected in order to include in the problem of proper analysis the difficulty of dealing with small numbers. During 1920 the average membership was 540, which constituted about 90 per cent of the average number employed by the company during the year.

THE PROBLEM DEFINED.

When a condition or a situation has been evaluated and the facts have been expressed in figures, the problem may be considered as defined. Table I and Figure 1 afford a definition of the preventive problem of the industrial physician or nurse in the establishments covered by the reports of the employee sick-benefit association under consideration.

TABLE I.—*Diseases causing disability among the 540 members of an employee sick-benefit association during 1920: Number of cases and calendar days lost from disabilities lasting 5 days or longer.*

Rank.	Diseases and conditions causing disability.[a]	Calendar days lost in 1920.	Number of cases which began in 1920.	Calendar days lost from cases which began in 1920.	Calendar days lost per case.
	All diseases and conditions	2,526	154	2,538	16.5
1	Influenza and grippe	761	69	756	11.0
2	Appendicitis	217	5	229	45.8
3	Rheumatism	216	4	164	41.0
4	Nonindustrial accidents	107	10	107	10.7
5	Purulent infection (blood poison)	100	4	100	25.0
6	Tonsillitis, sore throat, and quinsy	97	9	93	10.3
7	Heart trouble	82	2	82	41.0
8	Hernia	67	2	67	33.5
9	Colds	67	7	91	13.0
10	Skin diseases	65	8	65	8.1
11	Mumps	54	5	54	10.8
12	Lumbago and myalgia	49	5	49	9.8
13	Pneumonia	40	1	40	40.0
14	Stomach and intestinal disorders	35	4	85	21.3
15	Pleurisy	24	4	24	6.0
16	Neuralgia and neuritis	21	2	19	9.5
	All others	524	13	513	39.5

[a] Includes nonindustrial accidents causing disability for 5 days or longer.

The calendar days lost in 1920 from sickness and nonindustrial accidents which disabled for 5 days or longer were 2,526, or 4.68 calendar days per person. Because all disabilities of less than 5 days' duration are excluded, it is impossible at this time to make

comparisons with illness rates which include all lost time. An estimate of the complete morbidity rate could be made by ascertaining from the sickness experience of other companies what percentage of the total lost time ordinarily is due to illnesses of less than 5 days' duration, if the available data were not so scanty. This is but one illustration of the extent to which the field of industrial morbidity statistics lies untilled. With the material so meager it has been impossible to establish with any degree of accuracy the average or normal morbidity rate among industrial employees, and only in a few isolated instances have any attempts been made to measure the effect

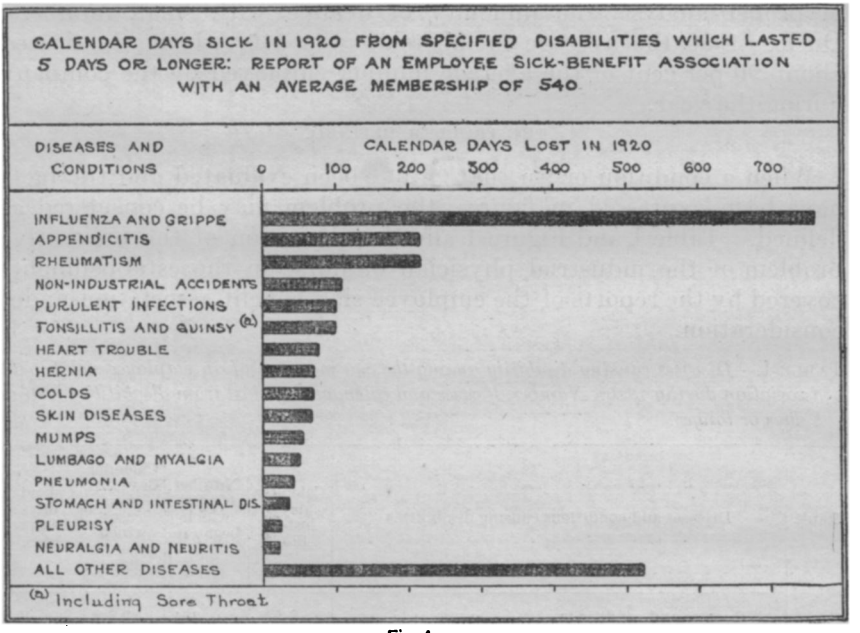

Fig. 1.

of industrial medical service. Recently a few statements have appeared concerning the accomplishment of establishment health work, as, for example: "Our statistics show a consistent reduction year by year of the average disability of nine days per man per year lost time to a little over four days per man, notwithstanding various epidemics that in recent years have resulted in such great morbidity."[3] The Norton Company, of Worcester, Mass., claims a 75 per cent reduction in loss of time on account of illness since the establishment of their medical department.[4]

[3] C. H. Lemon, chief surgeon, the Milwaukee Electric Railway & Light Co., in "Hospital Management" or October, 1920, p. 66.

[4] Stated by L. W. Wallace in an address on "The Conservation of Labor," delivered before the American Engineering Council, at Washington, and printed in "The American Machinist" (New York).

But even if comparable morbidity statistics are lacking, the table and graph showing causes of disability in one industrial group are not without interest and value. A point of significance which the table brings out is the large proportion of lost time due to illnesses that are usually included in the category of preventable diseases.

SICKNESS ACCORDING TO MILLS.

The membership of the sick benefit association under discussion is composed of employees of four different paper manufacturing plants, all in the same community, with the exception of Mill C, which is located in a neighboring city about 20 miles distant. Table II shows the severity rates for specific diseases in each of these mills.[5]

TABLE II.—*Sickness severity rates by mills for the principal diseases causing disability among the 540 members of an employee sick-benefit association during 1920.*[a]

Rank.	Diseases and conditions causing disability.	Calendar days lost per person in 1920.				
		All mills.	Mill A.	Mill B.	Mill C.	Mill D.
	All diseases and conditions	4.68	3.70	7.94	2.44	5.97
1	Influenza and grippe	1.41	1.40	1.43	.70	3.26
2	Appendicitis	.40	.28	1.07	.....	.....
3	Rheumatism	.40	.45	.20	.55	.....
4	Nonindustrial accidents	.20	.06	.98	.12	.71
5	Purulent infection (blood poison)	.19	.02	.33	.48	.....
6	Tonsillitis, sore throat, and quinsy	.18	.10	.42	.....	.40
7	Heart trouble	.15	.....	.61	.....	.....
8	Hernia	.12	.14	.22	.....	.....
9	Colds	.12	.12	.12	.18	.....
10	Skin diseases	.12	.16	.12	.....	.16
11	Mumps	.10	.08	.21	.06	.....
12	Lumbago and myalgia	.09	.17	.04	.....	.....
13	Pneumonia	.07	.....	.....	.....	1.05
14	Stomach and intestinal disorders	.07	.11	.....	.06	.....
15	Pleurisy	.05	.09	.....	.....	.....
16	Neuralgia and neuritis	.04	.08	.....	.....	.....
	All others	.97	.44	2.69	.29	.39
	Number of persons	540	265	134	104	38

[a] Includes only those cases of sickness and nonindustrial accidents which disabled for five days or longer.

It will be noticed that there was considerable variation in the sickness rates of the four mills. Since these variations might have been due to differences in the severity of the influenza epidemic at each mill, the rate for influenza and grippe should be deducted from the rate for all diseases. The days of disability per person then become: Mill A, 2.30; Mill B, 6.51; Mill C, 1.74; Mill D, 2.71. The only conspicuous difference now is the high rate at Mill B. What diseases, then, were responsible for the excessive disability at this plant?

The table shows a considerable time loss on account of appendicitis at Mill B, but since the relatively high incidence of this disease was probably accidental and had no relation to employment, the rate for appendicitis, also, should be deducted for comparative purposes.

[5] The sickness severity rate is usually expressed as the average number of days of disability from a certain disease or from all diseases per year per person included in the group or population under consideration.

When this is done, it is found that Mill B still has more than twice as much disability as any of the other three mills. From the table it is seen that rheumatism, colds, and skin diseases were not above the average at this plant; in fact, that none of the diseases listed were conspicuously above the average except heart trouble. In the group called "All others" is to be found most of the excess disability, indicating that the situation does not call for the elimination of a few specific diseases at this plant, but that the underlying causes of the high rate of sickness from a miscellaneous collection of diseases should be investigated. Possibly the age of the employees to some extent accounts for the situation. We know that under normal conditions, age is the largest single factor affecting the amount of time lost on account of illness. Since no data were collected on the age distribution of the membership and the age of persons sick, no adjustment for the age factor can be made in the present instance, but in a more complete analysis, this question should by all means be taken into account.

DISABILITY ACCORDING TO OCCUPATION.

The industrial physician is particularly interested in measuring the effect of work and working conditions upon the employees whom he endeavors to keep physically fit. In Table III are presented the number of new cases during the year and the amount of disability according to occupation. It is not intended even to suggest that this table measures adequately the influence of occupation upon health. It would only do so if all the persons considered were of the same physical and social status, the same age, if the extra-industrial environment were identical, and if transfers from one occupation to another during the year could be taken into account. Furthermore, it will be noticed that the number of persons engaged in some of the occupations specified is exceedingly small, a fact which accounts for some of the wide differences in the number of days lost per person in different occupations. The rate for the painters, for example, was 50 times the rate for the oilers; but inasmuch as there were only eight painters and five oilers, the figures of course greatly exaggerate the real difference in the health status of the two groups. With only a year's morbidity experience for a very small number of persons, most of the rates are not significant from the standpoint of representing morbidity that could be considered as typical of the group. Purely chance phenomena could account for wide fluctuations in the illness rates from year to year when a very small number of persons is involved. But for the purpose of furnishing a lead to the industrial physician, of the occupations or conditions of work which appear to be contributing to the disability occurring, morbidity rates for the principal occupations are of considerable value. It may be found in using the records of certain sick-benefit societies

that the leads are not always dependable, on account of the small number of persons involved; but if upon investigation it is found that the conditions of work do not account for the sickness occurring, it is important to establish that fact. In such cases the progressive employer will want to extend his activities beyond the confines of his factory and to cooperate with municipal authorities and civic associations to right whatever injurious conditions are found to be responsible for the excessive disability discovered.

TABLE III.—*Disabilities lasting 5 days or longer, by occupation: Number of new cases and calendar days lost per person by the membership of an employee sick-benefit association during 1920.*

Occupation.	Number of persons.	Number of new cases in 1920.						
		All diseases.	Rheumatism.[a]	Respiratory.[b]	Influenza and grippe.	Skin infections.	Hernia.	All others.[c]
All occupations	540	154	11	12	69	8	2	52
1. Yardmen (laborers)	78	28	3	2	14	1	.....	8
2. Wood-room workers	29	8	.....	.....	5	.....	.....	3
3. Firemen	14	2	1	.....	.....	.....	.....	1
4. Grinder men and block pilers	35	5	2	.....	3	.....	.....	.....
5. Roll skinners and wet-machine tenders	17	4	.....	1	2	.....	1	.....
6. Beater men	44	17	.....	3	6	1	.....	7
7. Paper-machine hands	85	20	2	1	5	1	1	10
8. Roll finishers and loaders	33	12	1	1	1	.....	.....	9
9. Oilers	5	1	1	.....	.....	.....	.....	.....
10. Painters	8	5	.....	.....	3	.....	.....	2
11. Cleaners	10	5	.....	1	1	.....	.....	3
12. Paper-box machine hands	22	10	.....	1	5	1	.....	3
13. Mechanics and repair men	40	12	.....	1	7	2	.....	2
14. Clerks, foremen, and superintendents	57	10	.....	.....	8	.....	.....	2
15. Other occupations	50	11	.....	1	6	2	.....	2
16. All female workers	13	4	1	.....	3	.....	.....	.....

Occupation.	Number of persons.	Calendar days lost per person in 1920.						
		All diseases.	Rheumatism.[a]	Respiratory.[b]	Influenza and grippe.	Skin infections.	Hernia.	All others.[c]
All occupations	540	4.68	0.53	0.24	1.41	0.12	0.13	2.25
1. Yardmen (laborers)	78	4.86	.40	.14	2.01	.12	.....	2.19
2. Wood-room workers	29	5.83	.....	.....	2.24	.....	.....	3.59
3. Firemen	14	3.29	2.86	.....	.....	.....	.....	.43
4. Grinder men and block pilers	35	1.63	.66	.....	.97	.....	.....	.....
5. Roll skinners and wet-machine tenders	17	4.41	.....	1.53	1.18	.....	1.70	.....
6. Beater men	44	5.39	.....	.34	2.05	.14	.....	2.86
7. Paper-machine hands	85	3.88	1.16	.06	.70	.12	.45	1.39
8. Roll finishers and loaders	33	5.91	1.73	.24	.52	.....	.....	3.42
9. Oilers	5	1.00	1.00	.....	.....	.....	.....	.....
10. Painters	8	50.00	2.37	.50	4.63	.....	.....	42.50
11. Cleaners	10	16.10	.....	.70	1.60	.....	.....	13.80
12. Paper-box machine hands	22	6.50	.....	1.82	2.36	.27	.....	2.05
13. Mechanics and repair men	40	2.83	.05	.15	1.70	.40	.....	.53
14. Clerks, foremen, and superintendents	57	1.72	.....	.....	1.42	.....	.....	.30
15. Other occupations	50	1.72	.....	.18	.84	.36	.....	.34
16. All female workers	13	2.46	.77	.....	1.69	.....	.....	.....

[a] Rheumatism (acute and chronic), lumbago, myalgia, neuralgia, and neuritis.
[b] Not including influenza and grippe, nor tuberculosis.
[c] Including nonindustrial accidents.

In the present instance (see Table III) the painters experienced by far the greatest amount of incapacitating illness. The rate of 42½ days of disability per person in this group for "all other" diseases was due, for the most part, to a case of lead poisoning which caused one person's absence from work for a year. The painters also lost considerable time in 1920 on account of rheumatism, influenza, and grippe, and other respiratory diseases. A rate so tremendous directs attention strikingly to the ill health of an occupational group and impresses one with the need of careful study and well-advised action for the purpose of correcting whatever conditions are found to be either wholly or partially responsible for the disability.

SEASONAL VARIATION IN DISEASE INCIDENCE.

Not only is it desirable to find out *where* disease occurs, but also to know *when* specific illnesses most frequently begin is information which the factory health organization wants. In Table IV and Figure 2, the seasonal variation in the occurrence of cases is shown, the well-defined peak being due, of course, to the influenza epidemic of 1920.

TABLE IV.—*Disabilities lasting 5 days or longer by month of onset: Frequency of diseases specified among 540 members of an employee sick-benefit association during 1920.*

Month.	Number of persons.	Number of new cases in 1920.						
		All diseases.	Rheumatism.[a]	Respiratory.[b]	Influenza and grippe.	Skin infections.	Hernia.	All others.[c]
All months	540	154	11	12	69	8	2	52
January	457	23	2	.....	14	.....	2	5
February	487	50	1	3	39	.....	.....	7
March	486	20	.....	1	9	.....	.....	10
April	494	5	.....	1	.....	.....	.....	4
May	542	5	4	.....	.....	.....	.....	1
June	558	4	.....	.....	.....	1	.....	3
July	548	5	1	.....	.....	1	.....	3
August	564	7	.....	1	.....	1	.....	5
September	571	5	.....	.....	.....	1	.....	4
October	583	6	.....	1	1	1	.....	3
November	596	10	3	.....	2	2	.....	3
December	599	14	.....	5	4	1	.....	4

Month.	Number of persons.	Number of new cases per 1,000 persons in 1920.						
		All diseases.	Rheumatism.[a]	Respiratory.[b]	Influenza and grippe.	Skin infections.	Hernia.	All others.[c]
All months	540	285.2	20.4	22.2	127.8	14.8	3.7	96.3
January	457	50.3	4.4	.....	30.6	.....	4.4	10.9
February	487	102.7	2.1	6.2	80.1	.....	.....	14.4
March	486	41.2	.....	2.1	18.5	.....	.....	20.6
April	494	10.1	.....	2.0	.....	.....	.....	8.1
May	542	9.2	7.4	.....	.....	.....	.....	1.8
June	558	7.2	.....	.....	.....	1.8	.....	5.4
July	548	9.1	1.8	.....	.....	1.8	.....	5.5
August	564	12.4	.....	1.8	.....	1.8	.....	8.9
September	571	8.8	.....	.....	.....	1.8	.....	7.0
October	583	10.3	.....	1.7	1.7	1.7	.....	5.1
November	596	16.8	5.0	.....	3.4	3.4	.....	5.0
December	599	23.4	.....	8.3	6.7	1.7	.....	6.7

[a] Rheumatism, acute and chronic, lumbago, myalgia, neuralgia, and neuritis.
[b] Not including influenza and grippe, nor tuberculosis.
[c] Including nonindustrial accidents.

The accompanying tables indicate what diseases caused the greatest amount of disability in the organization as a whole, in each mill and in the principal occupations. They show that if influenza and grippe, appendicitis, and rheumatism could have been eliminated, the rate would have been 2.47 instead of 4.68 days of disability per person. A saving of 10 per cent of the lost working time would have added about $1,000 to the wages of the group, as the demand for labor was active in this community throughout the year 1920. A

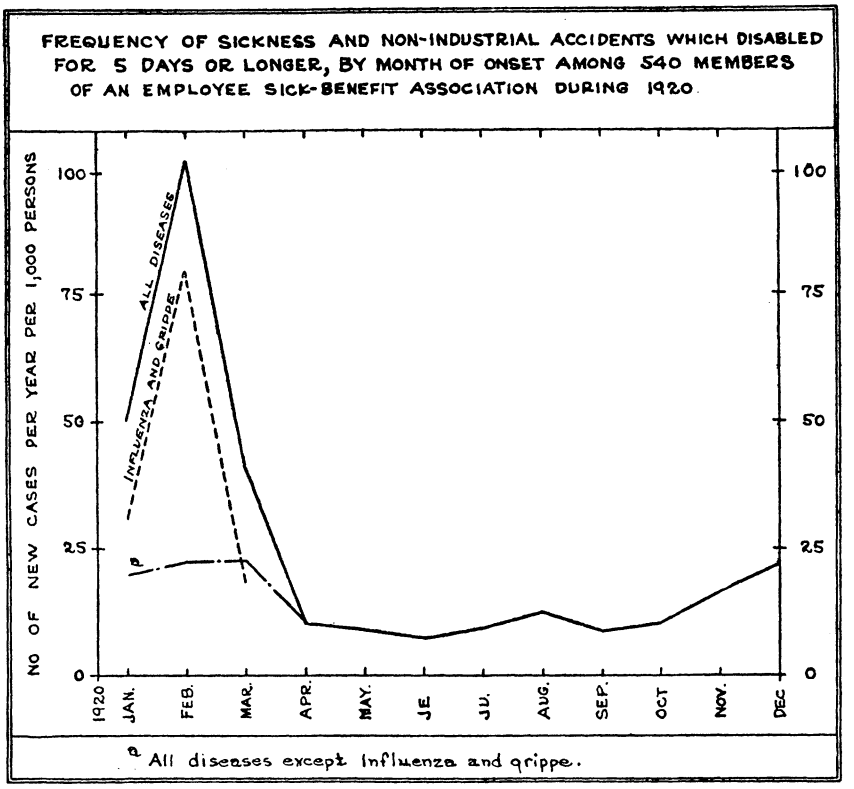

Fig. 2.

10 per cent reduction in the number of days of disability would have saved the association several hundred dollars in sickness benefits and medical aid, and would have added to the profits of the company.[6] The tables therefore afford some idea of the economic loss which the disability from sickness and nonindustrial accidents occasioned and the saving in dollars which well-organized factory health work might reasonably achieve.

The tabulation of disease incidence by months tells the factory health department *when* corrective measures might be instituted to

[6] For a discussion of the cost of absenteeism to the employer, the reader is referred to "Control of Absenteeism," by P. Sargent Florence, in the Administration Magazine for May, 1921.

the best advantage, and the analysis by plants and occupations shows *where* these diseases occurred, suggesting the groups to be studied in order to effect the greatest reduction in the disability rate.

These few tables do not by any means exhaust the possibilities for obtaining useful information from employee sick benefit association records. Other factors in disability, such as age, nationality, marital status, physical defects, etc., doubtless could be easily incorporated in the records of many sick benefit societies and used in a cooperative study of these factors by several sick benefit associations or by a group of associations in cooperation with the Public Health Service.

The exclusion of all cases which do not last as long as the waiting period of course prevents knowledge of the complete story, but a study of the more serious cases can not fail to yield information of value to the whole factory organization. To the plant physician such tables are a guide and a challenge.

CONTAMINATED OYSTERS SOURCE OF TYPHOID EPIDEMIC AT HAVRE, FRANCE.

The following account of an outbreak of typhoid fever at Havre, France, is taken from "Le Petit Havre" of January 21, 1922.

During the last four months of 1921 there was a marked increase in the number of cases of typhoid fever at Havre, amounting to over five times the number of cases reported during the preceding eight months. The cases were disseminated throughout the city, not being confined to any particular quarter.

The source of the outbreak was definitely traced by the Municipal Bureau of Hygiene to the consumption of contaminated oysters. It was ascertained that oysters from recognized sanitary oyster beds were being "freshened up" by immersion in sea water from the inner and outer harbor, both of which were known to be contaminated by impurities from the city. This practice was officially prohibited on December 24, 1921, and from that date to January 16, 1922, the number of cases fell to 6 as against 35 for the whole month of December. The records of the bureau of hygiene for the year 1921 show the occurrence of typhoid fever in Havre by months as follows: January, 0; February, 4; March, 5; April, 2; May, 5; June, 2; July, 1; August, 3; *September*, 17; *October*, 44; *November*, 26; *December*, 35—122 cases (with 28 deaths) from September to December as against 22 cases during the preceding eight months.

During the war, when oyster fishing was prohibited, the number of typhoid fever cases in the civilian population did not exceed seven or eight per annum. From 1918 the number increased, particularly during the autumn and winter (oyster season).